

APPENDIX D-1

ANALYSES OF THE LINKAGE BETWEEN PAY AND PERFORMANCE: METHODS FOR STATISTICAL ANALYSES

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As in previous years, the body of this report contains results from statistical analyses performed on the objective data pertaining to the Demonstration and Comparison Group participants. In this technical appendix, we provide more detail on the statistical analyses from which the results were derived as well as other methodological issues of relevance to the study design. The following information is provided:

- Use of sample versus census data analysis techniques
- Results of the regression analysis
- Scatterplot displaying the performance score-bonus correlation in the Demonstration Group
- Results of the analysis of covariance (ANCOVA).

Use of Sample Versus Census Data Analysis Techniques

The database of Demonstration Group participants represents the entire universe of DoC employees who are receiving the human resource interventions as part of this Demonstration Project. By definition this group is a population rather than a sample. The most widely used inferential statistics, and those used as part of this evaluation (Analysis of Covariance), were designed to be applied to sample data. Despite this theoretical hurdle, it has become common practice among researchers to use these inferential statistics in the absence of a better method.

To most accurately describe the population in question, Booz Allen produced effect size estimates along with significance levels. By producing these additional data, Booz Allen hopes to mitigate the theoretical concerns of applying data analysis techniques developed for samples on data derived from a population.

Results of the Regression Analysis

Our regression analysis in Year Five, as in Year Four, is based on the analysis performed for the NIST Demonstration Project where the relationship between pay and performance is estimated considering additional factors that may also influence pay. Due to statistical factors associated with the relationship between Initial Year Five Salary and End of Year Five Salary data, this analysis was altered in Year Five to assess the effects of performance score on salary increase (rather than on end of year salary as was considered in Year Four). By assessing the relationship between performance score and performance-based salary increase we are able to more accurately answer the question, “are performance ratings still related to pay increases when additional factors are considered in the same analysis?”

The following factors were considered in Year Five as they relate to performance based salary increase: Initial Year Five Salary (salary prior to pay increases, in dollars), pay band as of September 2002, interval as of September 2002, whether or not one was promoted in Year

Five, supervisory status (supervisor/non-supervisor), length of service, performance score, race, gender, veteran status, and age. The regression analysis was conducted separately for each career path. In essence, the regression analysis looks at the degree to which each of these factors is related to performance based salary increase in Year Five.

Similar to Year Four results, analyses show that performance score is related to pay distribution for all four of the career paths. Higher salary increases are associated with higher performance scores and lower salary increases are related to lower performance scores. While performance score was the only variable that consistently predicted salary increase across all four of the career paths, variables such as promotion in Year Five, length of service, interval, and age were also related to salary increase in at least two of the career paths. As may be expected, in Year Five, higher pay bands tend to be associated with greater salary increases. However, greater length of service, interval, and age are associated with lower salary increases, as may also be expected due to the nature of the pay system and the capacity for more junior employees to receive greater percentage salary increases (due to the lower position of these employees in their bands). In addition, Year Five promotions were associated with lower salary increases. These results suggest that those employees who were promoted had smaller performance based increases relative to those employees who received regular performance based increases; one hypothesis may be that employees who received an increase due to promotion, received a smaller performance-based increase. These promotion results may warrant further evaluation in future years.

Statistically speaking, the factors included in this analysis account for 38% (ZP), 43% (ZT), 30% (ZA), and 41% (ZS) of the variance in salary increases. The following tables provide more detail as to which variables account for the variance in salary increases. Only variables listed in these tables have a significant effect on salary increases. As explained in Table 1, Demographic variables of race, gender, and veteran status were found to not influence pay. These results were consistent across career paths.

Table 1: Results of Regression Analysis

ZP Career Path

Variables	B	Beta	R	Adjusted R-squared
Initial Year Five salary (prior to increases)*	-4.244	-.071	.071	.005
Performance Score	28.966	.464	.616	.376
Length of Service	-408.500	-.945		
Promotion in Year Five	-276.385	-.050		
Age	-22.483	-.172		
Band as of September 2002	1377.501	.866		
Supervisory Status	-848.930	-.198		

Note: Variables not included because they did not significantly increase the prediction of salary increase: Interval as of September 2002, Race, Gender, and Veteran Status. This analysis was performed in SPSS. The negative B and Beta for Supervisory Status simply reflects that Supervisory Status had been coded as "1" for Supervisors and "2" for Non-supervisors. Therefore, the interpretation of this negative value is that higher salary increases were associated with being a supervisor.

**Due to statistical factors associated with the relationship between Initial Year Five Salary and Salary Increase, Initial Year Five salary was treated as a control variable (results highlighted in gray) so that the effects of this variable could be estimated separately, as to estimate the effects of the other predictor (independent) variables more precisely.*

ZT Career Path

Variables	B	Beta	R	Adjusted R-squared
Initial Year Five salary (prior to increases)*	1.998	.366	.366	.129
Performance Score	10.725	.371	.672	.428
Length of Service	768.576	3.153**		
Age	-11.140	-.169		
Interval as of September 2002	-852.346	-.759		

Note: Variables not included because they did not significantly increase the prediction of salary increase, Band as of September 2002, Promotion in Year Five, Supervisory Status, Race, Gender, and Veteran Status. This analysis was performed in SPSS.

**Due to statistical factors associated with the relationship between Initial Year Five Salary and Salary Increase, Initial Year Five salary was treated as a control variable (results highlighted in gray) so that the effects of this variable could be estimated separately, as to estimate the effects of the other predictor (independent) variables more precisely.*

***While the relationship between length of service and salary increase in this regression may beg additional analysis due to its anomalous beta weight greater than one, this relationship does not affect our ability to test the main question regarding the degree to which performance is related to pay.*

ZA Career Path

Variables	B	Beta	R	Adjusted R-squared
Initial Year Five salary (prior to increases)*	3.432	.049	.049	.001
Performance Score	29.611	.450	.560	.303
Promotion in Year Five	1395.838	-.222		
Interval as of September 2002	-742.675	-.451		

Variables not included because they did not significantly increase the prediction of end salary: Pay band as of September 2002, length of service, Supervisory Status, Race, Gender, Veteran Status, and Age. This analysis was performed in SPSS.

**Due to statistical factors associated with the relationship between Initial Year Five Salary and Salary Increase, Initial Year Five salary was treated as a control variable (results highlighted in gray) so that the effects of this variable could be estimated separately, as to estimate the effects of the other predictor (independent) variables more precisely.*

ZS Career Path

Variables	B	Beta	R	Adjusted R-squared
Initial Year Five salary (prior to increases)*	7.112	.093	.093	.006
Performance Score	11.171	.608	.652	.414

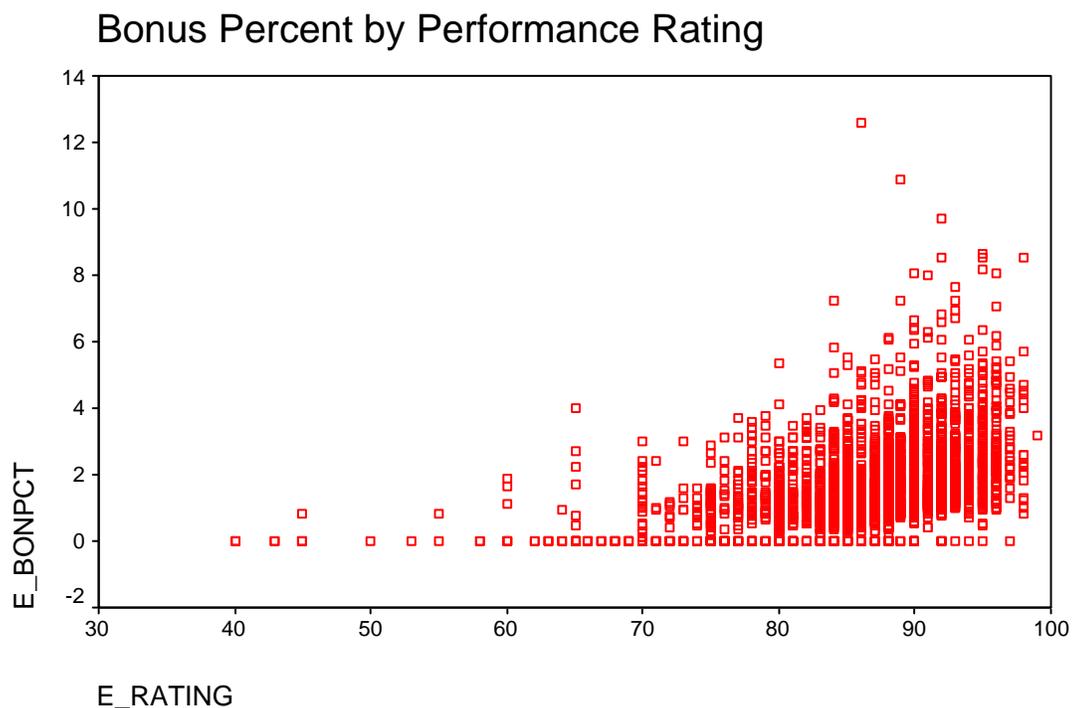
Variables not included because they did not significantly increase the prediction of end salary: Interval as of September 2002, Pay band as of September 2002, Promotion in Year Five, Supervisory Status, Length of Service, Race, Gender, Veteran Status, and Age. This analysis was performed in SPSS.

**Due to statistical factors associated with the relationship between Initial Year Five Salary and Salary Increase, Initial Year Five salary was treated as a control variable (results highlighted in gray) so that the effects of this variable could be estimated separately, as to estimate the effects of the other predictor (independent) variables more precisely.*

Scatterplot Displaying the Performance Score-Bonus Correlation in the Demonstration Group

Figure 1 displays a scatterplot showing the relationship between performance scores and bonuses (as a percentage of base salary) in the Demonstration Group. Correlational analyses revealed a correlation of $r = .44$ ($p < .01$). The scatterplot below suggests that the employees receiving low performance scores were unlikely to receive a large bonus. Additionally, those employees who did receive a large bonus were more likely to have received a high performance score.

Figure 1. Bonus Percent by Performance Score



Results of the Analysis of Covariance (ANCOVA)

Analysis of variance (ANOVA) involves determining whether the difference between two or more means is statistically significant. Analysis of covariance (ANCOVA, also referred to as ANACOVA) builds one more level of complexity. With ANCOVA, those differences between the means are examined while also *controlling* for the effects that another variable or variables may have on the relationship. That is, the question becomes "what is the effect of something when we take into account something else?" (Will G. Hopkins, A New View of Statistics).

When performing ANCOVAs, the output produces means that account for the presence of other specified variables. These means are known as "adjusted" means; they allow closer examination of the relationship between two variables of interest while removing the impact that other variables may have on the relationship.

Using a standard statistical software, the Statistical Package for the Social Sciences (SPSS), Booz Allen ran ANCOVA analyses to assess any differences in pay outcomes for EEO groups and veterans within the Demonstration Project. As in previous years, separate ANCOVA analyses were run for each protected subgroup (i.e., minorities, women, and veterans) to test whether the new pay-for-performance system adversely affected subgroups. In essence, the ANCOVA analyses indicate whether differences for subgroups in average pay increases or bonuses/awards were significant. We examined, for example, differences in average pay increases for females and males. In this example we sought to determine whether 1) there was a statistically significant difference in average pay increases between females and males and 2) whether the size of the effect of gender on average pay increases was large enough to be meaningful.

Separate ANCOVAs were run for several independent variables whose categories were:

1. Minority/non-minority
2. Female/male
3. Veteran/non-veteran

Separate ANCOVAs for each of these subgroups were performed for each of the two dependent variables of interest:

1. Percent Increase in Salary (amount of the performance-based pay increase expressed as a percent of salary from the beginning of the performance year)
2. Percent Bonus/Award (amount of bonus/award expressed as a percent of salary from the beginning of the performance year)

As reported in prior reports, ANCOVAs were calculated using three covariates: Performance Score, Career Path, and Time in Service. The ANCOVA analyses were used to address the question of how much impact gender, for example, had on differences in Percent Increase in Salary once the effects of Performance Score, Career Path, and Time in Service were statistically accounted for.

In these analyses, values less than .01 in the column labeled “Significance” were considered significant. Due to the large number of cases in the data set, it was not unexpected to find that many relationships were statistically significant. Because so many of these relationships were statistically significant, it is important to also consider the Eta squared value.

The column labeled “Eta Squared” is the estimate of the size of the effect that each independent variable had on the dependent variable of interest (Percent Increase in Salary or Percent Bonus/Award). For these data, values greater than .05 were considered to be of interest. However, consistent with past years, none of the EEO group variables in any of the analyses reached this level.

For each ANCOVA analysis, raw and estimated marginal means are presented. The raw measures are labeled “Unadjusted Means.” The estimated marginal means are means that have been adjusted for the covariates and are labeled “Adjusted Means.”

In summary, the findings presented below indicate that while many relationships between the independent variables and the dependent variables were statistically significant (due to the large sample size), none had an effect on the distribution of pay increases or bonuses/awards large enough to be meaningful.

DEMONSTRATION GROUP DATA

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Minority/Non-Minority			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Minority	2.61%	2.06	537
Non-Minority	2.78%	2.22	2186
ANCOVA Results		Significance	Eta Squared
Career Path		.000	.008
Performance Score		.000	.169
Time in Service		.000	.240
Minority/Non-Minority		.001	.004
Group	Adjusted Means	Standard Error	
Minority	2.52%	.080	
Non-Minority	2.81%	.039	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Female/Male			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Female	3.09%	2.32	1102
Male	2.52%	2.07	1621
ANCOVA Results		Significance	Eta Squared
Career Path		.000	.009
Performance Score		.000	.167
Time in Service		.000	.226
Female/Male		.936	.000
Group	Adjusted Means	Standard Error	
Female	2.75%	.056	
Male	2.75%	.046	

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Veteran/Non-Veteran			DEMO GROUP
Group	Unadjusted Means	Standard Deviation	N
Veteran	2.26%	2.04	369
Non-Veteran	2.82%	2.20	2354
ANCOVA Results		Significance	Eta Squared
Career Path		.000	.009
Performance Score		.000	.167
Time in Service		.000	.235
Veteran/Non-Veteran		.485	.000
Group	Adjusted Means	Standard Error	
Veteran	2.69%	.096	
Non-Veteran	2.76%	.038	

Dependent Variable = Percent Bonus Independent Variable Categories = Minority/Non-Minority			DEMO GROUP	
Group	Unadjusted Means	Standard Deviation	N	
Minority	1.68%	1.31	537	
Non-Minority	1.80%	1.30	2186	
ANCOVA Results		Significance	Eta Squared	
Career Path		.000	.008	
Performance Score		.000	.205	
Time in Service		.000	.011	
Minority/Non-Minority		.032	.002	
Group	Adjusted Means	Standard Error		
Minority	1.68%	.051		
Non-Minority	1.80%	.025		

Dependent Variable = Percent Bonus Independent Variable Categories = Female/Male			DEMO GROUP	
Group	Unadjusted Means	Standard Deviation	N	
Female	2.02%	1.53	1102	
Male	1.61%	1.10	1621	
ANCOVA Results		Significance	Eta Squared	
Career Path		.000	.007	
Performance Score		.000	.195	
Time in Service		.001	.004	
Female/Male		.000	.017	
Group	Adjusted Means	Standard Error		
Female	1.97%	.035		
Male	1.64%	.029		

Dependent Variable = Percent Bonus Independent Variable Categories = Veteran/Non-Veteran			DEMO GROUP	
Group	Unadjusted Means	Standard Deviation	N	
Veteran	1.52%	1.22	369	
Non-Veteran	1.81%	1.31	2354	
ANCOVA Results		Significance	Eta Squared	
Career Path		.000	.008	
Performance Score		.000	.201	
Time in Service		.000	.009	
Veteran/Non-Veteran		.015	.002	
Group	Adjusted Means	Standard Error		
Veteran	1.64%	.061		
Non-Veteran	1.80%	.024		

COMPARISON GROUP DATA

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Minority/Non-Minority			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Minority	1.51%	1.78	201
Non-Minority	1.52%	1.74	1354
ANCOVA Results		Significance	Eta Squared
Career Path		.130	.001
Performance Score		*	.000
Time in Service		.000	.036
Minority/Non-Minority		.764	.000
Group	Adjusted Means	Standard Error	
Minority	1.49%	.121	
Non-Minority	1.53%	.047	

* Comparison Group employees included in this analysis all received a rating of "passing" in Year Five.

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Female/Male			COMPARISON
Group	Unadjusted Means	Standard Deviation	N
Female	1.62%	1.76	552
Male	1.46%	1.74	1003
ANCOVA Results		Significance	Eta Squared
Career Path		.126	.002
Performance Score		*	.000
Time in Service		.000	.034
Female/Male		.948	.000
Group	Adjusted Means	Standard Error	
Female	1.52%	.074	
Male	1.52%	.055	

* Comparison Group employees included in this analysis all received a rating of "passing" in Year Five.

Dependent Variable = Percent Increase in Salary Independent Variable Categories = Veteran/Non-Veteran			COMPARISON	
Group	Unadjusted Means	Standard Deviation	N	
Veteran	1.08%	1.58	190	
Non-Veteran	1.58%	1.76	1365	
ANCOVA Results		Significance	Eta Squared	
Career Path		.218	.007	
Performance Score		*	.000	
Time in Service		.000	.035	
Veteran/Non-Veteran		.001	.007	
Group	Adjusted Means	Standard Error		
Veteran	1.15%	.125		
Non-Veteran	1.57%	.046		

* Comparison Group employees included in this analysis all received a rating of "passing" in Year Five.

Dependent Variable = Percent Award Independent Variable Categories = Minority/Non-Minority			COMPARISON	
Group	Unadjusted Means	Standard Deviation	N	
Minority	1.80%	1.69	201	
Non-Minority	2.03%	2.04	1354	
ANCOVA Results		Significance	Eta Squared	
Career Path		.836	.000	
Performance Score		*	.000	
Time in Service		.054	.002	
Minority/Non-Minority		.115	.002	
Group	Adjusted Means	Standard Error		
Minority	1.80%	.141		
Non-Minority	2.03%	.054		

* Comparison Group employees included in this analysis all received a rating of "passing" in Year Five.

Dependent Variable = Percent Award Independent Variable Categories = Female/Male			COMPARISON	
Group	Unadjusted Means	Standard Deviation	N	
Female	2.30%	1.82	552	
Male	1.84%	2.25	1003	
ANCOVA Results		Significance	Eta Squared	
Career Path		.766	.000	
Performance Score		*	.000	
Time in Service		.389	.000	
Female/Male		.000	.010	
Group	Adjusted Means	Standard Error		
Female	2.28%	.086		
Male	1.85%	.063		

* Comparison Group employees included in this analysis all received a rating of "passing" in Year Five.

Dependent Variable = Percent Award Independent Variable Categories = Veteran/Non-Veteran			COMPARISON	
Group	Unadjusted Means	Standard Deviation	N	
Veteran	1.70%	1.66	190	
Non-Veteran	2.04%	2.04	1365	
ANCOVA Results		Significance	Eta Squared	
Career Path		.925	.000	
Performance Score		*	.000	
Time in Service		.082	.002	
Veteran/Non-Veteran		.036	.003	
Group	Adjusted Means	Standard Error		
Veteran	1.71%	.145		
Non-Veteran	2.04%	.054		

* Comparison Group employees included in this analysis all received a rating of "passing" in Year Five.